against the valley walls and bottom, or against each other. This is largely true even of the pebbles rolled on its bottom, as anyone may see by examining the nick-marks that cover their surfaces and that sharply distinguish them from glaciated pebbles, or by critically comparing a waterworked surface with a glacially worn surface.

On the other hand a glacier does its work by virtue of its rigidity and pressure, and scarcely at all by its momentum, for its velocity is very low. A river with the same velocity as a glacier would be almost absolutely inert as an abrading agency. In the judgment of the reviewer no one is entitled in the present state of evidence to assume that the laws of fluids control the action of glaciers except in external similitude, which is due to the fact that gravitation is the dominant factor in both cases. In convenient and popular exposition the similitude has many advantages, but in framing scientific doctrine and nomenclature, and still more in mental procedure, it is attended by danger. It is doubtless as important to avoid the similitude in critical work as it is permissible to use it in easy exposition.

T. C. C.

Bartholomew's Physical Atlas: An Atlas of Meteorology. Vol. III. A series of over four hundred maps. Prepared by J. G. BARTHOLOMEW, F.R.S.E., and A. J. HERBERTSON, PH.D., and edited by Alexander Buchan, F.R.S. Under the patronage of the Royal Geographical Society. Edinburgh, 1899.

This is the first volume to appear of what promises to be an epoch making work in scientific geography. The entire field of physical geography is to be covered by seven volumes. The plan was furnisht by the famous *Physikalischer Atlas* of Berghaus, tho the field is vastly extended, and it will make a work when completed, perhaps ten times the size of the German atlas.

This great venture is preparing under the direction of J. G. Bartholomew, revised and edited by a corps of eminent specialists, in volumes as follows:

I. Geology — Sir Archibald Geikie.
II. Oceanography — Sir John Murray; and
Orography — Professor James Geikie.
III. Meteorology — Alexander Buchan,
IV. Botany — Professor Bayley Balfour.

V. Zoölogy — P. L. Sclater.
VI. Ethnography — Professor A. H. Keane; and
Demography — Professor Elisee Reclus.
VII. Cosmography — Professor Ralph Copeland; and
Magnetism — Professor C. G. Nott.

It is now about half a century since the appearance of a great English work along these lines, that of Dr. Keith Johnston, based on the *Physikalischer Atlas* of Dr. Heinrich Berghaus (1837–1852). The original German publication is justly regarded as a landmark in the history of geography, and has been kept at the forefront of high art in cartography by his nephew, Dr. Hermann Berghaus, who brought to his aid some of the most famous German scholars, such as Hann, Neumayr, Zittel, and others. This is the work which has been such an inspiration to the students of geology and geography in the present generation, and this atlas it is which has furnisht the plan for the greater Scotch work now in preparation. To quote from the prospectus:

Recent years have marked a great and rapid development in the field of scientific geography. The additions to our previous knowledge have been numerous and important, but they are scattered throughout hundreds of publications, in various languages, they are difficult to find, and known only to specialists in each department. Hence there is a need for a work embodying in concrete and graphic form a digest of all this scattered material — a new physical atlas.

So some years ago the enterprising Scotch firm obtained copyright privileges on the material in the Berghaus plates, and planned at much larger work, one of over two hundred plates, compiled from sources liable to be of more immediate interest to English and American students, getting the heartiest coöperation from the world's greatest specialists along all the desirable lines; ten years have already gone to the preparation of the most comprehensive work of the kind ever attempted. The cost of production alone will reach a half million dollars.

Curiously enough meteorology, the youngest of the physical sciences, is so far advanced in the accumulation of data from very wide areas of the earth's surface, that it is in the most forward condition of all as to the possibility of charting complete data. Mr. Alexander Buchan makes this rather startling statement:

If the present state of the science of meteorology as regards the geographical distribution of results be compared with that of the other sciences such as

geology and the biological sciences, it stands second to none. None of these sciences can show such a world-wide distribution of precise results as are collected in this atlas of meteorology, in illustration of the geographical distribution of temperature, pressure, humidity, cloud, rainfall, and movements of the atmosphere, with illustrations of their influences over, and interrelations with, each other.

Dr. Hann's *Atlas der Meteorologie* was the first attempt to chart systematically the data of the science. His atlas, as found in Berghaus, has twelve plates, giving about sixty maps. And, altho this has been brought down to 1887, there has been a very great advance in all lines of the science since then, and the time is ripe for a more complete publication. A mass of widely scattered observations from all over the world is now charted for the first time.

The 400 maps of this atlas of meteorology are groupt under the two heads of Climate and Weather. The climate maps summarize the great mass of observations, first for the whole world, next for more detailed study of regions specially rich in observational data. There are monthly and annual charts for the elements of climate—temperature, pressure, winds, cloud, sunshine, and rainfall. The weather maps show the most characteristic weather types for given periods over defined regions.

Preceding the charts there is a general introductory article, and a special discussion of each chart. This will be of the highest value to students of climate and the weather. Appendices give complete lists of all the meteorological services, with all the stations and publications. The frontispiece consists of a graphic charting of the areal distribution of observations over the earth, in which India, Europe, and the United States stand out conspicuously in their dark shading. The volume closes with a glossary of terms, and a critical bibliography, classified for all lines of research in the subject, both of which will be very helpful.

The magnitude of the undertaking of the preparation of these charts, and the accuracy we are here dealing with will be better realized when some plain statement of the figures is made. The total number of meteorological stations is, in round numbers, 380 of the Order I; 2620 of the Order II; 6600 of the Order III, and of Rainfall, 19,400; total, 29,000; special stations for crop reports will bring the grand total up to about 31,000.

The general temperature charts are based upon fifteen years' observations from 1539 stations. The general pressure charts from fifteen years' observations at 1280 stations. These reports are the summaries of about 17,000,000 observations for temperature, and about 14,000,000 for pressure, and this is excluding all observations at sea.

The charts of the first part under the general heading Climate, are classified under the headings:

I. Isotherms.
II. Isobars and wind arrows.
III. Isotherms and Isobars month to month.
IV. Isohels, the year's sunshine for Europe and North America.
V. Isonephs, distribution of cloudness over the globe.
VI. Isohyets, annual, seasonal and monthly rainfall over the globe.
VII. Maps of hyetal regions and seasonal distribution,
VIII. Isobars and Isohyets; rainfall as related to pressures.

The second part on Weather, has charts classified as:

I. Abnormally cold and hot seasons and months.
II. Pressures as related to wind in type storms.
III. Pressures as related to types of wind and weather.
IV. Storm tracks and storm frequency.
V. Type deviations from normal pressures.

The first chart in the volume shows the world's isotherms on Mercator's projection, in which the relief of the land is shown by line shadings in black. Contours of 600, 3000, 6000, and 12,000 feet are shown, and similar contours in the oceans represented by fine dotted lines. Even the little 3×6-inch insets show all highlands over 3000 feet by shading. This plate and No. 11, the world's isobars, are equally beautiful, and are the finest plates in the book. It will be no exaggeration to say that no more beautiful plates have ever been engraved. They are magnificent in accuracy, neatness, completeness and beauty of engraving, nor are the lesser maps less beautiful, they are merely smaller, and chart less complex data as a rule. One is struck, too, by the artistic range of coloring. The tints show with a sufficient contrast the varying values of the data charted, yet there is not a harsh note in the whole book.

Two of the most beautiful plates in the book are the charts of the monthly isotherms of the British Isles, and another of the monthly isobars and isohyets.

In all the maps the English measurements are given, and in each case their metric equivalents — the pity of it, that we need to record in two systems!

It almost seems like caviling to offer any criticism on so sumptuous a work. But there are some shortcomings. In only one case is the projection used named; it would have been an agreeable addition, had the projection been specified for all maps of lesser area, and in all such maps a horizontal scale should be given, either in arithmetical ratio, or by linear representation of miles and kilometers. There is scarcely a scale in the book.

In all maps of isohyets the very important element of altitude, it would seem, is almost a necessity for the proper interpretation of the rainfall, yet on Plate XXI, the principal plate of isohyets, there is no attempt to show altitudes, even in the larger areas of Europe and the United States. The lack of contours and the scale in such insets as Jamaica, Japan, Java, and Mauritius is a serious fault. Even in Plate XXIV in the large scale map of isobars and isohyets of the United States and Canada, only the one contour of 3000 feet is shown. Here, far more than in the general maps of Plates I and II, are the several contours needed. It may be, of course, that in some cases, for example, the India map, the relief was omitted to prevent overloading. And true it is, that with all the mass of data entered in these maps, there is never in any of them a lack of legibility.

But after all the flaws are found, they are not very serious, they are mere spots on the sun. The work will long stand as a monument to very high ability in meteorology and cartography.— J. PAUL G.

Mineral Resources of Kansas, 1899. By ERASMUS HAWORTH, Univ. Geol. Surv. of Kansas, Lawrence, May 1900; pp. 67, 4 plates.

This is the third of the annual bulletins on the mineral resources of the state which the University Geological Survey of Kansas is issuing, and is worthy of note as a laudable effort on the part of an educational institution of high grade to convey to the people, without distinction and without charge, commercially valuable information gathered under scientific auspices. Is is one of the many current indications of the breaking down of the narrow limitations that have so long hedged in the traditional institution of learning to its infinite